Applicants' claimed invention generally relates to color imaging and, more particularly, transformation of color image data for reproduction of color images using different types of imaging devices. Applicants' invention has a number of different aspects, discussed in detail below.

As background, Applicants first point out that different types of imaging devices exhibit varied responses to input color image data. Indeed, color matching has become one of the most challenging problems in the art of color imaging. In response to a given set of input color image data, one type of imaging device may produce color output that is significantly different from the color output produced by another type of imaging device.

For example, the color output of a particular printer may be markedly different form the color output of a display device such as a cathode ray tube (CRT) monitor, even though the devices are presenting the same image. In addition, there may be significant variation among different imaging devices of the same type, such as different printers.

To achieve more consistent color output among different devices, i.e., color matching, the input color image data can be transformed to compensate for color response differences among different devices. Transformation may involve numeric adjustment of individual color values contained in the input color image data. The transformation process is sometimes referred to as color correction or conversion. The transformation takes into account the individual color response characteristics of a particular imaging device.

Typically, the transformation relies on a source device profile and a destination device profile. As is known in the art, a source profile characterizes the color response of a source device, whereas a destination profile characterizes the color response of the destination device. The source device may be an imaging device for which the input color image data was initially formulated. The destination device is the device selected by a user to reproduce the image.

To achieve similar output from the destination device, a color matching module interprets the source and destination device profiles to determine the differences between the devices, and develops a color map, or "link," that compensates for those differences. Applicants' Disclosure, page 4, lines 17-19. The color map relates source device coordinates to destination device coordinates, and thereby facilitates transformation of the input color image data. Applicants' Disclosure, page 8, lines 10-16, page 10, lines 5-14. For a display device, the device coordinates

may be red, green, and blue (RGB). For a printer, the device coordinates typically are cyan, magenta, yellow and black (CMYK).

Applicants' disclosure describes a color matching module that not only makes use of source and destination device profiles, but also user preferences, to define a color mapping between source and destination imaging devices. Applicants' Disclosure, page 15, lines 15-22. In particular, the color matching module may incorporate a source device profile interpreter to interpret a source device profile, a destination device profile interpreter to interpret a destination device profile, and a color transformer to generate a color map defining a relationship between source and destination device color spaces based on converted coordinates generated by the interpreters. An exemplary color matching module is shown in FIG. 2 of Applicants' Disclosure and presented below.

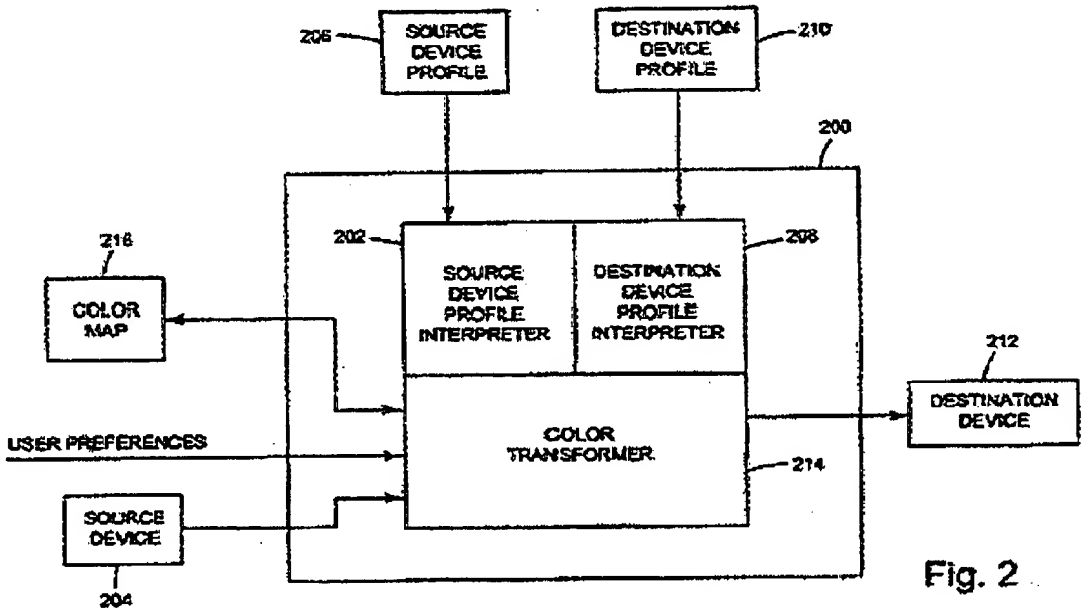

Fig. 2

Notably, in addition to the converted coordinates, the color transformer also makes use of user preferences specified by a user independently of the source and destination device profiles. One or more user preferences modules may serve as "plug-in" modules that feed user preference information to the color matching module. Again, in some embodiments, the user preferences may relate to illuminant functions or observer functions.

By permitting the user to specify user preferences, such as illuminant and observer functions, independently of the source and destination profiles, the claimed invention provides greater flexibility and enhanced processing efficiency. Additional examples of user preferences are selected gamut mapping and selected device-independent color space.

Other color matching modules typically account for illuminant and observer functions within the source and destination profiles. Consequently, if the user changes the illuminant function, observer function, or both, the source and destination profiles ordinarily must be recalculated. On the contrary, according to the claimed invention, user preferences such as the illuminant and observer functions can be decoupled from the source and destination profiles, and serve as independent inputs to the color transformer.

As a result, there is no need to recompute the source and destination profiles when the user changes a preference such as illuminant function or observer function. Instead, the color transformer relies on the existing profiles and processes the changes to the user preferences independently of the profiles. Accordingly, the claimed invention permits ease and flexibility in specifying user preferences while mitigating the significant computational overhead that would otherwise be required if the profiles were updated.

Claim Rejections Under 35 U.S.C. § 103

Claims 25, 28, 29, 31-33, 35-38, 41 and 44 - Swen et al. in view of Liang

In the Office Action, the Examiner rejected claims 25, 28-29, 31-33, 35-38, 41 and 44 under 35 U.S.C. 103(a) as being unpatentable over Swen et al. (US 5,806,081) in view of Liang (US 5,579,031). Applicants respectfully traverse this rejection. The applied references fail to disclose or suggest the claimed invention, and provide no teaching that would have suggested the desirability of modification to arrive at the claimed invention.

In his analysis, the Examiner cited Swen et al. as disclosing the invention of claim 25, substantially as claimed. In particular, the Examiner characterized Swen et al. as disclosing a source device profile interpreter, a destination device profile interpreter, and a color transformer that generates a color map based on coordinates converted by the source and destination device profile interpreters.

At first, the Examiner seemed to suggest that Swen et al. also discloses generation of a color map based on both (a) converted coordinates produced by interpretation of source and destination device profiles and (b) user preferences that are specified by a user independently of the source and destination device profiles, as set forth in Applicants' claims. The Examiner then contradicted himself, however, and acknowledged that "Swen et al. does not specifically disclose that 'generating a color map use of both converted coordinates produced by interpretation of source and destination device profiles and user preferences' (emphasis added)."

Next, in light of the acknowledged shortcomings in Swen et al., the Examiner cited Liang. In particular, the Examiner characterized Liang as teaching:

> the use of the colorimeter 36 for measuring color patches 132 and 134 for compiling 2 transformation profiles, which is the two LUTs, for generating two respective set of device independent color values, which are the 2 Lab color spaces (models 140, 142), and further constructing a color map describing a relationship between the color imaging system using the color conversion LUT 128. (See col 10 line 64-67, col. 11 line 1-9, col 12, line 67-col 13 line 6, Fig 7-8)

The Examiner then stated that it would have been obvious to incorporate the teaching of Liang in the Swen et al. in order to provide higher quality color reproduction and mapping.

The Examiner's analysis appears to overlook a basic element of Applicants' claims, and is therefore puzzling. In particular, the Examiner specifically acknowledged that Swen et al. fails to teach the generation of a color map based on both (a) converted coordinates produced by interpretation of source and destination device profiles and (b) user preferences that are specified by a user independently of the source and destination device profiles. Yet, the passages cited by the Examiner in the Liang reference seem to bear no relationship to this requirement of Applicants' claims. Nowhere does the Examiner's discussion of Liang identify a teaching that relates to the generation of a color map based on user preferences in combination with converted coordinates, as defined in claims 25, 38, 41 and 44. Consequently, Applicants' claimed invention would not be achieved even if the system described by Swen were modified in view of Liang as suggested by the Examiner.

Moreover, the passages cited by the Examiner do not seem to be relevant. At Col. 10, lines 64-67, Liang describes the printing of two sets of color patches by two respective printers 112, 114. At Col. 11, lines 1-9, Liang describes the use of a colorimeter to measure the patches

and thereby form two lookup tables (LUTs) representing the transfer functions of the two printers. According to Liang, the LUTs are used to produce models 140, 142 for the printers. At Col. 12, line 67, to Col. 13, line 16, Liang appears to refer to the fact that different sets of color values may be capable of producing the same colorimetric output, and describes the use of an optimization function to select one of the sets of color values that produces better overall color matching results.

Hence, the Examiner's analysis appears to be preoccupied with a number of entirely conventional features described by Liang, yet completely overlooks the crux of Applicants' claimed invention. For example, the Examiner's characterization of Liang focuses on the use of a colorimeter to measure color patches, the formation of transformation profiles, and construction of a color map. However, Applicants are unable to find any relationship between these features and the specific feature that the Examiner recognized was lacking from Swen et al., i.e., generation of a color map based on both (a) converted coordinates produced by interpretation of source and destination device profiles and (b) user preferences that are specified by a user independently of the source and destination device profiles. Without addressing this feature, the grounds of rejection are clearly deficient.

Consequently, Applicants are at a loss to understand why one of ordinary skill in the art would have found it obvious to modify the Swen et al. system in view of Liang. More importantly, it is unclear how the purported modification of the Swen et al. system in view of Liang would even result in the claimed invention. Applicants are simply unable to find any mention of the missing features in Liang or any other prior art of record. Upon proper attention to the actual requirements of Applicants' claims, the fundamental shortcomings of Liang in establishing a prima facie case of obviousness should be apparent.

For the reasons above, Applicants respectfully submit that the Swen et al. and Liang references fail to support a prima facie case of unpatentability. Claims 28, 29, 31-33, 35-37 are patentable for at least the reasons stated above. Applicants request withdrawal of the rejection of claims 25, 28, 29, 31-33, 35-38, 41 and 33. If the Examiner somehow elects to maintain this rejection, however, Applicants respectfully request that he point out the specific teachings in Liang that would have suggested modification of Swen et al. to generate a color map based on both (a) converted coordinates produced by interpretation of source and destination device

profiles and (b) user preferences that are specified by a user independently of the source and destination device profiles, as set forth in Applicants' claims.

Claims 26, 27, 30, 34, 39, 40, 42, 43, 45, 46 – Swen et al. in view of Liang and Rozzi

The Examiner rejected claims 26, 27, 30, 34, 39, 40, 42, 43, 45 and 46 under 35 U.S.C. 103(a) as being unpatentable over Swen et al. (US 5,806,081) in view of Liang (US 5,579,031), and further in view of Rozzi (US 6,232,954). Applicants respectfully traverse this rejection. The applied references fail to disclose or suggest the claimed invention, and provide no teaching that would have suggested the desirability of modification to arrive at the claimed invention.

The Examiner recognized that neither Swen et al. nor Liang discloses generation of a color map based on converted coordinates and user preferences specified by a user independently of the source and destination device profiles, wherein the user preferences include illuminant functions as set forth in claims 26, 39, 42, and 45, or wherein the user preferences include observer functions as set forth in claims 27, 40, 43 and 46.

The Examiner cited Rozzi, however, as making mention of the use of illuminant and observer functions. On this basis, the Examiner concluded that it would have been obvious to modify the Swen et al. system, as modified according to Liang, to "include such illuminant/observer functions . . . in order to provide high-accuracy color reproduction, which is preferable to users." Applicants respectfully traverse the rejection of claims 36, 37, 39, 40, 42, 43, 45, and 46.

Rozzi describes the application of standard illuminant and observer curves to convert spectral reflectances into XYZ tristimulus values. However, Rozzi provides no teaching that would have suggested generation of a color map based on converted coordinates and user preferences specified by a user independently of source and destination device profiles, wherein the user preferences include illuminant functions or observer functions, as claimed.

Moreover, Applicants hereby advise the Examiner that the Rozzi patent does not qualify as prior art under 35 U.S.C. 103(c). The subject matter described in the Rozzi reference and the claimed invention were, at the time the invention was made, subject to an obligation of assignment to the same person. Specifically, the subject matter described in Rozzi and the claimed invention were both subject to an obligation of assignment to Minnesota Mining and

Manufacturing Co. (3M) at the time of invention. Therefore, the Rozzi reference cannot form the basis of an obviousness rejection under section 103.

The Examiner also relied on Rozzi for teachings with respect to the requirement that the source and destination device profile interpreters are configured based on white- and black-point parameters to account for color variations between media and colorants used by different color display devices, as set forth in claim 30, and the requirement that the source device profile contains raw spectral data that characterizes a source device, and the destination device profile contains raw spectral data that characterizes a destination device, as set forth in claim 34. Again, the Rozzi reference does not qualify as prior art. Therefore, any rejection of claims 26, 27, 30, 34, 39, 40, 42, 43, 45 and 46 must be withdrawn, to the extent such rejection relies on the Rozzi reference.

Claims 25, 38, 41 and 44 – Swen et al. in view of Lindbloom

The Examiner further rejected claims 25, 38, 41 and 44 under 35 U.S.C. 103(a) as being unpatentable over Swen et al. (US 5,806,081) in view of Lindbloom ("Accurate Color Reproduction for Computer Graphics Applications" Computer Graphics, Vol. 23, Number 3, July 1989). Applicants respectfully traverse this rejection. The applied references fail to disclose or suggest the claimed invention, and provide no teaching that would have suggested the desirability of modification to arrive at the claimed invention.

As in the rejection based on Swen et al. and Liang, the Examiner again characterized Swen et al. as disclosing a source device profile interpreter, a destination device profile interpreter, and a color transformer that generates a color map based on coordinates converted by the source and destination device profile interpreters. Although the Examiner acknowledged that Swen et al. does not suggest generation of a color map based on both (a) converted coordinates produced by interpretation of source and destination device profiles and (b) user preferences that are specified by a user independently of the source and destination device profiles, he cited Lindbloom for such a teaching.

In particular, the Examiner pointed to page 123, section 7.1, of Lindbloom. With no discussion or further elaboration as to the content of the Lindbloom reference, the Examiner simply stated that it would have been obvious "to incorporate the teaching of Lindbloom into the

teaching of Swen et al., in order to provide higher quality color reproduction/mapping with easy and friendly manner." The Examiner added that "such improvement is also advantageously desirable in the teaching of Swen et al. for obtaining the closest CMMs, thereby producing optimized result."

Applicants are unable to find any teaching in Lindbloom that is pertinent to the feature missing from Swen et al. Specifically, neither section 7.1 nor any other section of Lindbloom describes the generation of a color map based on both (a) converted coordinates produced by interpretation of source and destination device profiles and (b) user preferences that are specified by a user independently of the source and destination device profiles. Therefore, as in the case of Liang above, Applicants are simply at a loss to understand why the Lindbloom reference was cited.

Neither the cited portion of Lindbloom nor the Examiner's remarks explain where Lindbloom contains the alleged teaching. Section 7.1 of Lindbloom reads as follows:

> In a typical color mapped application the user interacts with simple 2D graphics such as lines and polygons. The geometric objects are colored by number, using a color look up table to define the appearance of the relatively small (typically <=256) set of colors. These colors are stored in the graphics file as (L*, u*, v*), although the user interface software presents the user with more useful controls such as companded RGB (using the methods of § 6.1 and 6.2) and possibly HSV and HSL[8], which are derivations of RGB. Colors may be mixed specifically for any display device by using the appropriate device characterization parameters during the conversion to and from (L*, u*, v*). When the design session is over, a device independent color table is stored.

In the above passage, Lindbloom describes the assignment of color values to geometric objects within an image, and the use of device characterization parameters to handle conversion between device-dependent RGB colors and device-independent L*, u*, v* colors.

Lindbloom further states in section 7.1 that "[w]hen this file is to be displayed on a device, the (L*, u*, v*) to RGB process is applied, using the characterization parameters for the particular display device class, followed by the transformation to the physical device coordinates using local calibration information." Hence, Lindbloom describes a process that relies on a color characterization for a category of devices, such as a particular printer or display model produced

by the same manufacturer, and a local calibration that accounts for differences among individual devices in that category, e.g., as a result of manufacturing differences or device drift over time.

No portion of Lindbloom makes any mention whatsoever of the generation of a color map based on both (a) converted coordinates produced by interpretation of source and destination device profiles and (b) user preferences that are specified by a user independently of the source and destination device profiles. Therefore, Applicants are unable to discern the basis for the Examiner's reliance on Lindbloom. As with Liang, modification of the Swen et al. system according to Lindbloom clearly would not result in the requirements of the claimed invention. Indeed, the Examiner did not even explain what those modifications would entail, let alone the result of such modifications. This rejection is improper and should be withdrawn.

CONCLUSION

All claims in this application are in condition for allowance. Applicant respectfully requests reconsideration and prompt allowance of all pending claims. Please charge any additional fees or credit any overpayment to deposit account number 50-1778. The Examiner is invited to telephone the below-signed attorney to discuss this application.

Date: 4-9-04

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